

REMARKS

Claims 1-19 and 22-25 are pending in the patent application. Claims 3, 8, 14-19 and 22-25 have been withdrawn from consideration. Claims 6, 11 and 18 have been amended. The amendments to claims 11 and 18 have broadened these claims to cover Cartesian polarizing beam splitters that include a multilayer optical film. New claim 26 has been added. No new matter has been introduced.

The Examiner required a supplementary declaration or oath because the originally submitted declaration listed the wrong filing dates of the priority application. The Examiner also required that the reference to the priority applications in the Specification be changed to show the correct filing dates. The Specification has been amended as required. A copy of the supplemental declaration, listing the filing dates of the priority applications as required by the Examiner, accompanies this Response.

Rejection under 35 U.S.C. § 112

Claim 6 was rejected under 35 U.S.C. § 112, second paragraph, for being vague and indefinite. Claim 6 has been amended. The amendment to claim 6 clarified the invention without narrowing the scope of the invention. It is believed that all claims comply with 35 U.S.C. § 112.

Rejections under 35 U.S.C. § 102

Claim 13 is rejected under 35 U.S.C. § 102(b) as being anticipated by Gagnon et al (U.S. Patent No. 4,425,028) (Gagnon). It is stated in the Office Action that Gagnon discloses a projection system comprising a polarizing beamsplitter (22 or 24) and a color separation prism (24, 28 or 32) wherein the axes of the polarizing beamsplitter and color separation prism are perpendicular. Gagnon teaches a projection system in which light from a light source (38) is directed to a first color selective beamsplitter or prepolarizer (22), which removes the green s-polarized light. The transmitted light propagates to the second polarizing beamsplitter (24) that reflects a portion of the light in a beam (108) to a dichroic separator (28). The dichroic separator reflects green light to a green liquid crystal light valve assembly (44). Green image light is reflected from the green liquid

crystal light valve assembly, via the dichroic separator and through the second polarizing beamsplitter to a projection lens (56). The light transmitted through the second polarizing beamsplitter from the first color selective beamsplitter is transmitted to a second dichroic separator (32) which reflects red light to a red liquid crystal light valve (48) and transmits the blue light to the blue liquid crystal light valve (50). Image light reflected by the red and blue light valve assemblies is transmitted back to the second polarizing beamsplitter and then reflected to the projection lens.

The invention of claim 13 is directed to a projection system comprising a Cartesian polarizing beam splitter (PBS), the Cartesian PBS defining a first tilt axis, and a color separation prism assembly having a second tilt axis. The Cartesian PBS and the prism assembly are arranged such that the first and second tilt axes are perpendicular to each other.

To anticipate a claim, the reference must teach every element of the claim. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051 1053 (Fed. Cir.) 1987). "The identical invention must be shown in as complete detail as is contained in the...claim." Richardson v. Suzuki Motor Co., 868 F. 2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). Therefore, if a reference does not teach every element of the claim, then the reference does not anticipate the claim (see MPEP § 2131). Gagnon fails to teach all the elements of claim 13, and so does not anticipate claim 13.

First, Gagnon does not teach a color separation prism assembly. Instead, Gagnon teaches the use of color-sensitive polarizing beamsplitter (22 and 24) and dichroic mirrors (28 and 32) to separate the incoming white light into red, green, and blue components in particular polarization states. These elements are different from a color separation prism assembly.

The components taught by Gagnon do not constitute a color separation prism assembly, and one of ordinary skill in the art would not understand Gagnon to teach a color separation prism assembly. As evidence of this, the Examiner is referred to, for example, Bryars (U.S. Patent No. 5,986,815), also cited by the Examiner in a 102 rejection of the current claim. This reference lists different types of "color splitting

means" at col. 10, lines 45-51, including Philips prisms, X-prisms, L-prisms, beamsplitter cubes and dichroic mirrors. Bryars, therefore, distinguishes among dichroic reflectors, beamsplitter cubes and prism-type color separators. Accordingly, one of ordinary skill would understand that the term "color separation prism assembly" would not cover a combination of beamsplitter cubes and dichroic mirrors. Instead, one of ordinary skill would understand from the claim that polarization separation was performed by the Cartesian polarizing beamsplitter while color separation was performed separately by the color separation prism assembly. Gagnon's system, on the other hand, intermixes the functions of polarization separation and color separation, relying on the use of color-sensitive polarizers and dichroic mirrors. As a result, Gagnon does not teach the use of a color separation prism assembly.

Second, Gagnon fails to teach the use of a Cartesian PBS. Instead, Gagnon refers to the light passing through the various polarizing beamsplitters as p-polarized or s-polarized. A definition of a Cartesian PBS is presented in the present Application at page 7, lines 16-17, *viz.* a Cartesian PBS is one in which the polarization of the separate beams is referenced to invariant, generally orthogonal, principal axes of the PBS. Consequently, the interaction of the Cartesian PBS is characterized by how the incident light is polarized with respect to the PBS axis.

In contrast, the interaction of a conventional PBS, such as a McNeille PBS, is characterized in terms of how the incident light is polarized with respect to the plane of incidence. As an example, incidence at Brewster's angle on a conventional polarizer surface results in light being totally transmitted, without reflection, only if the polarization of the light is parallel to the plane of incidence (p-polarized). If the light is incident on the surface in a direction not completely parallel to the plane of incidence, then there exists a reflected component. On the other hand, a Cartesian PBS transmits substantially all of the incident light even if the light is not polarized parallel to the plane of incidence, so long as the light is polarized parallel to the correct axis of the polarizer. Thus, the Cartesian and non-Cartesian polarizers are fundamentally different from one another. Gagnon fails to teach the use of a Cartesian PBS.

Therefore, since Gagnon fails to teach all the elements of claim 13, Gagnon does not anticipate claim 13, and claim 13 is allowable thereover.

Claim 13 is rejected under 35 U.S.C. §102(b) as being anticipated by Nagashima (JP 63039394). Nagashima shows a polarizing beamsplitter (21) that reflects light from a light source (23) towards a color prism assembly (11).

The term "tilt axis" as defined in the present application is described in page 13, line 3 – page 14, line 23, with reference to FIGs. 2a and 2b. The tilt axis (56) of the polarizing beamsplitter (32) is the axis about which the reflecting surface is rotated to turn the surface away from normal incidence. Likewise, the tilt axes (58) of the color separation prism assembly (36) are the axes about which the reflecting surfaces of the prisms are rotated to turn the reflecting surfaces away from normal incidence. As can be seen in Nagashima's Figure 1, the tilt axes of the PBS and the turning prism project out of the plane of the figure, and are parallel. This can be compared to the embodiment of the invention illustrated in Figure 2b of the present application, in which the tilt axes are illustrated to be perpendicular. Thus, Nagashima fails to teach that the tilt axes are perpendicular.

Furthermore, Nagashima fails to teach the use of a Cartesian PBS.

Accordingly, since Nagashima fails to teach all the elements of claim 13, Nagashima fails to anticipate claim 13, and so claim 13 is allowable over Nagashima.

Claim 13 is rejected under 35 U.S.C. § 102(e) as being anticipated by Bryars (U.S. Patent No. 5,986,815) (Bryars '815). Bryars '815 fails to teach all the elements of claim 13. In particular, Bryars '815 fails to teach that the tilt axes of the Cartesian PBS and the color separation prism assembly are perpendicular. Bryars '815 shows, in FIG. 1, a projection system having light source (10) that illuminates a PBS (20). The light reflected from the PBS is directed to a Philips type of prism assembly (30), formed by three prisms R, G, and B. Prism R has a reflecting surface (41b) and prism G has a reflecting surface (51b). The tilt axes of the PBS, and the two reflecting surfaces are all parallel, and lie out of the plane of the figure. Accordingly, Bryars '815 fails to teach that the tilt axes of the PBS and the color separation prism assembly are perpendicular.

Furthermore, Bryars '815 fails to teach the use of a Cartesian PBS.

Accordingly, since Bryars '815 fails to teach all the elements of claim 13, Bryars '815 fails to anticipate claim 13, and so claim 13 is allowable over Bryars '815.

Claim 13 is rejected under 35 U.S.C. § 102(e) as being anticipated by Bryars et al. (U.S. Patent No. 6,144,498) (Bryars '498). Bryars '498 fails to teach all the elements of claim 13. In particular, Bryars '498 fails to teach that the tilt axes of the Cartesian PBS and the color separation prism assembly are perpendicular. Bryars '498 shows, for example in FIG. 2, a projection system having light source (102) that illuminates a PBS (106). The light reflected from the PBS is directed to a prism assembly (10), formed by three prisms R, B, and G. Prism R has a reflecting surface (22bb) and prism B has a reflecting surface (24b). The tilt axes of the PBS, and the two reflecting surfaces are all parallel, and lie out of the plane of the figure. Accordingly, Bryars '498 fails to teach that the tilt axes of the PBS and the color separation prism assembly are perpendicular.

Furthermore, Bryars '498 fails to teach the use of a Cartesian PBS.

Accordingly, since Bryars '498 fails to teach all the elements of claim 13, Bryars '498 fails to anticipate claim 13, and so claim 13 is allowable over Bryars '498.

Claim 13 is rejected under 35 U.S.C. 102(e) as being anticipated by Kuijper (U.S. Patent No. 6,250,762 B1). Kuijper teaches a projection system having a light source (5) that illuminates a PBS (9). Light reflected by the PBS is directed to a color-separating element (17), comprised of three prisms 19, 21, and 23. This is referred to as a "plumbicon" prism. Blue light is reflected at the first interface (25), and red light is reflected at the second interface (27).

The tilt axes of the PBS, and the two reflecting surfaces are all parallel, and lie out of the plane of the figure. Accordingly, Kuijper fails to teach that the tilt axes of the PBS and the color separation prism assembly are perpendicular.

Furthermore, Kuijper fails to teach the use of a Cartesian PBS.

Accordingly, since Kuijper fails to teach all the elements of claim 13, Kuijper fails to anticipate claim 13, and so claim 13 is allowable over Kuijper.

Claim 13 is also rejected under 35 U.S.C. § 102(e) as being anticipated by Knox (U.S. Patent No. 6,390,626 B2). Knox teaches a projection system having a light source (210) that illuminates a PBS (220). Light reflected by the PBS is directed to various embodiments of color separating prism assemblies, including a Philips color prism (330), in FIGs. 13 and 17, prism assembly (430) in FIG. 14, and prism (530) in FIG. 16. Each

of the prism assemblies taught by Knox includes reflecting surfaces for separating and combining light of different colors.

The tilt axes of the PBS, however, and the reflecting surfaces in each prism assembly are all parallel, and lie out of the plane of the respective figures. Accordingly, Knox fails to teach that the tilt axes of the PBS and the color separation prism assembly are perpendicular.

Accordingly, since Knox fails to teach all the elements of claim 13, Knox fails to anticipate claim 13, and so claim 13 is allowable over Knox.

Since claim 13 is allowable over all the art cited in the Office Action, and since claim 13 is a generic claim, Applicants respectfully request that claims 14-18, which depend from claim 13, be reinstated in the present application for consideration.

Rejections under 35 U.S.C. § 103

Claims 1, 2, 4-7 and 9-12 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Nagashima in view of Duwaer et al. (U.S. Patent No. 5,146,248) (Duwaer). It is stated in the Office Action that Nagashima discloses all of the subject matter claimed, as described in the discussion of the rejection of claim 13, with the exception for explicitly stating that the illumination system has a f/# less than or equal to 2.5. It is further stated in the Office action that Duwaer teaches that it is well known to use an illumination system having an f/# less than or equal to 2.5 in the same field of endeavor for the purpose of producing a large cone of light, and that it would have been obvious at the time the invention was made to modify the illumination system of Nagashima to include a typically illumination system having a f/# less than or equal to 2.5 as taught by Duwaer, in order to increase the brightness efficiency without sacrificing contrast or desirable brightness versus contrast ratio.

Claims 1, 2, 4-7 and 9-12 are also rejected under 35 U.S.C. § 103(a) as being unpatentable over Bryars ('815) or Bryars (498) in view of Duwaer, and unpatentable over Kuijper in view of Duwaer and unpatentable over Knox in view of Duwaer, all for the same reasons as discussed above with respect to the rejection based on the proposed combination of Nagashima and Duwaer. All of these 103 rejections are discussed together, since they all fail for the same reasons.

Duwaer discusses a light valve projection system based on the use of three separate light sources (30, 40 and 50) emitting light at different wavelengths. Respective reflectors (34, 44, and 54) collect the light to illuminate respective transmissive light valves (36, 46 and 56). The image light transmitted through the light valves is combined in a Philips color prism (38, 48, 58), and projected using a projection lens (60). Duwaer indicates that the illumination system for this transmission-type imaging system may be as low as f/2.0.

Three criteria must be met to establish a *prima facie* case of obviousness. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. Second, there must be a reasonable expectation of success. Finally, the prior art reference, or combination of references, must teach or suggest all the claim limitations. MPEP § 2142. Applicant respectfully traverses the rejection since the prior art fails to disclose all the claim limitations.

Claim 1 is directed to an optical imaging system that comprises an illumination system providing a beam of light, the illumination system having an f/# less than or equal to 2.5. A Cartesian PBS has a first tilt axis, oriented to receive the beam of light. The Cartesian PBS nominally polarizes the beam of light with respect to the Cartesian PBS. A first polarized beam of light having a first polarization direction is folded by the Cartesian PBS and a second polarized beam of light having a second polarization direction is transmitted by the Cartesian PBS. A color separation and recombination prism is optically aligned to receive one of the polarized beams of light. The prism has a second tilt axis, a plurality of color separating surfaces, and a plurality of exit surfaces. The second tilt axis is oriented perpendicularly to the first tilt axis of the Cartesian PBS so that the polarized beam is nominally polarization rotated into the opposite polarization direction with respect to the color separating surfaces and a respective beam of colored light exits through each of the exit surfaces. The system further includes a plurality of polarization modulating imagers, each imager placed at one of the exit surfaces of the color separating and recombining prism to receive one of the respective beams of colored light. Each imager can separately modulate the polarization state of the respectively incident beam of colored light.

There are several reasons why the proposed combinations of references fail to teach all the claimed elements. First, a feature of the invention of claim 1 is that the second tilt axis of the color separation and recombination prism is perpendicular to the first tilt axis of the Cartesian PBS. As is discussed above, the tilt axis is defined in the present application in FIGs. 2a and 2b, and at page 13, line 3 – page 14, line 23. In accordance with that definition, as discussed above with respect to the rejections of claim 13 under 35 U.S.C. § 102, none of Nagashima, Bryars ('815), Bryars ('498), Kuijper and Knox teach that the color separating and recombining prism has a tilt axis perpendicular to the tilt axis of the PBS. Instead, each of these references teach that the tilt axis of the color separating prism is parallel to the tilt axis of the PBS. Duwaer fails to rectify this deficiency. In fact, Duwaer does not even teach the use of a PBS, since Duwaer's system is based on transmission-type liquid crystal displays. Accordingly, the proposed combinations of references all fail to teach or suggest that the tilt axes of the PBS and the color separation prism are perpendicular.

Second, although Duwaer does teach an illumination system having an f/# of 2.0, it is important to note that this is for a transmission type of light valve, and not a reflection type of light valve. Consequently, Duwaer's system simply combines the image light in the Philips prism and then projects the combined image using a projection lens. A reflection-based imaging system, on the other hand, uses a PBS to separate the reflected image light from the incoming light. This requires a PBS having a particularly wide acceptance angle in order to illuminate with an f/# less than 2.5, as is taught in the present application and the parent application, which is incorporated by reference. None of the cited references, either individually or in combination teach or suggest that it was known to use an illumination system having an f/# of 2.5 or less for a reflective imaging system.

Therefore, the proposed combinations of Nagashima, Bryars ('815), Bryars ('498), Kuijper or Knox with Duwaer all fail to teach or suggest all the elements of the invention of claim 1.

Furthermore, there would be no reasonable expectation of success, nor would there be motivation to combine the references as suggested in the Office Action. None of the prior art cited in the Office Action teaches or suggests a PBS that could efficiently

be used in a projection system with illuminating light having an f/# of 2.5 or less. Therefore, while Duwaer taught a low f/# transmissive projection system, there was no wide angle PBS that could be used in a low f/# reflective projection system. Accordingly, one of ordinary skill would have had no reasonable expectation that combining Duwaer's teachings with the projection systems taught by Nagashima, Bryars ('815), Bryars ('498), Kuijper or Knox would have resulted in a more efficient projection system.

In view of the above, Applicants respectfully assert that the proposed combinations of references fail to teach or suggest all the elements of the invention of claim 1 and that there would have been no reasonable expectation of success in producing a projection system with increased efficiency by making the proposed combinations. Accordingly, claim 1 is not obvious in view of the cited art and is patentable thereover.

Dependent claims 2, 4-7, and 9-12, which depend from independent claim 1 and further define the invention of independent claim 1, were also rejected under 35 U.S.C. §103(a) as being unpatentable over the same combinations of references. While Applicants do not acquiesce with the particular rejections to these dependent claims, it is believed that these rejections are moot in view of the remarks made in connection with independent claim 1. Therefore, dependent claims 2, 4-7 and 9-12 are also in condition for allowance.

New claim 26 is directed to a projection system where the Cartesian polarizing beam splitter is disposed so that illumination light reaching the color separation prism assembly via the Cartesian polarizing beamsplitter is in substantially the same polarization state across all color bands. This is illustrated in FIG. 2b and the description thereof. No new matter has been added. This claim depends from claim 13 which is allowable.

In view of the amendments and reasons provided above, Claims 1, 2, 4-7 and 9-13 are in condition for allowance. Applicant respectfully requests favorable reconsideration and early allowance of all pending claims. Furthermore, Applicants respectfully request that all pending claims not currently under consideration be reinstated and allowed.

If a telephone conference would be helpful in resolving any issues concerning this communication, please contact the below-signed attorney at 952-253-4110.

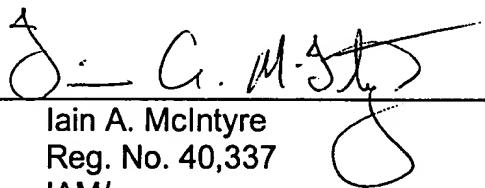
Respectfully submitted,

Altera Law Group, LLC



Date: January 24, 2003

By:


Iain A. McIntyre
Reg. No. 40,337
IAM/

Appendix A
Marked Up Version of the Entire Claim Set

The entire set of pending claims is provided for the Examiner's convenience.

1. (unchanged) An optical imaging system comprising:
 - a) an illumination system providing a beam of light, the illumination system having an f/# less than or equal to 2.5;
 - b) a Cartesian polarizing beam-splitter having a first tilt axis, oriented to receive the beam of light, wherein the Cartesian polarizing beam splitter nominally polarizes the beam of light with respect to the Cartesian beam-splitter, wherein a first polarized beam of light having a first polarization direction is folded by the Cartesian polarizing beam splitter and a second polarized beam of light having a second polarization direction is transmitted by the Cartesian polarizing beam splitter;
 - c) a color separation and recombination prism optically aligned to receive one of the polarized beams of light, said prism having a second tilt axis, a plurality of color separating surfaces, and a plurality of exit surfaces, wherein the second tilt axis is oriented perpendicularly to the first tilt axis of the Cartesian polarizing beam-splitter so that the polarized beam is nominally polarization rotated into the opposite polarization direction with respect to the color separating surfaces and a respective beam of colored light exits through each of the exit surfaces; and
 - d) a plurality of polarization modulating imagers, each imager placed at one of the exit surface of the color separating and recombining prism to receive one of the respective beams of colored light, wherein each imager can separately modulate the polarization state of the beam of colored light incident on said imagers.
2. (unchanged) The optical imaging system of claim 1, wherein the first polarization direction is nominally s-polarization and the second polarization direction is nominally p-polarization.

3. (unchanged) The optical imaging system of claim 1, wherein the first polarization direction is nominally p-polarization and the second polarization direction is nominally s-polarization.

4. (unchanged) The optical imaging system of claim 1, wherein the illumination system provides a beam of substantially pre-polarized light.

5. (unchanged) The optical imaging system of claim 1, wherein the color separation and recombination prism includes at least three exit surfaces, and the plurality of imagers includes at least three imagers, wherein each of the colored light beams is a different color and each imager receives one of the different color light beams.

6. (once amended) The optical imaging system of claim 1, wherein each imager reflects a polarization modulated image, wherein [each image enters] the images reflected by the imagers enter the color separation and recombination prism and the prism recombines the images into a single combined image, wherein the combined image is transmitted by the Cartesian polarizing beam splitter.

7. (unchanged) The optical imaging system of claim 6, further comprising a projection lens assembly, wherein the combined image is projected by the lens assembly onto a surface for viewing.

8. (unchanged) The optical imaging system of claim 1, wherein the optical system is a front projection system.

9. (unchanged) The optical imaging system of claim 1, wherein the optical system is a rear projection system.

10. (unchanged) The optical imaging system of claim 1, wherein the color separation and recombination prism includes a Philips prism.

11. (once amended) The optical imaging system of claim 1, wherein the Cartesian polarizing beam splitter includes a [APF] multilayer optical film.

12. (unchanged) The optical imaging system of claim 1, wherein the polarization modulating imagers include a LCOS imager.

13. (unchanged) A projection system comprising:

- a) a Cartesian polarizing beam splitter, the Cartesian polarizing beam splitter defining a first tilt axis;
- b) a color separation prism assembly, the prism assembly having a second tilt axis;
- c) wherein the Cartesian polarizing beam splitter and the prism assembly are arranged such that the first and the second tilt axes are perpendicular to each other.

14. (unchanged) The projection system of claim 13, further comprising an illumination system providing a beam of light, the illumination system having an f/# less than or equal to 2.5.

15. (unchanged) The projection system of claim 13, wherein the projection system is a front projection system.

16. (unchanged) The projection system of claim 13, wherein the system is a rear projection system.

17. (unchanged) The projection system of claim 13, wherein the color separation prism assembly includes a Philips prism.

18. (once amended) The projection system of claim 13, wherein the Cartesian polarizing beam splitter includes [APF] a multilayer optical film.

19. (unchanged) A projection engine for displaying an image, the projection engine comprising:

- a) a Cartesian polarizing beam-splitter having invariant, generally orthogonal principal axes including a first tilt axis; wherein the Cartesian polarizing beam splitter reflects a first polarization component beam of an incident beam of light and transmits a second polarization component beam, the polarization of the separate component beams being referenced to the principal axes; and
- b) a color separating prism assembly, optically aligned to receive one of the polarization component beams, the prism assembly having a plurality of color separating surfaces having tilt axes, the tilt axes of the color separating prism assembly being perpendicular to the first tilt axes of the Cartesian polarizing beam splitter.

22. (unchanged) The projection engine of claim 19, further comprising an illumination system providing the incident beam of light, the illumination system having an f/# of at most 2.5.

23. (unchanged) The projection engine of claim 19, further comprising a plurality of imagers, wherein the prism assembly has a plurality of exit surfaces and each imager is optically aligned with respect to a corresponding exit surface.

24. (unchanged) The projection engine of claim 23,

- a) further comprising a projection lens assembly;
- b) wherein each imager is a polarization modulating reflective imager and the prism assembly is a color separating and recombining prism assembly;
- c) wherein the prism assembly receives the one polarization component beam and separates the polarization component beam into a plurality of color beams;

d) wherein each color beam exits through a respective exit surface and a portion of the color beam is polarization modulated and reflected by the respective imager; and

e) wherein the reflected portions of the color beams re-enter the prism assembly and are recombined into a single image beam, the image beam being directed by the Cartesian polarizing beam splitter to the projection lens assembly, wherein the projection lens assembly projects an image.

25. (unchanged) The optical imaging system of claim 1, wherein the Cartesian polarizing beam splitter is a wire grid polarizer.

26. (new) The projection system of claim 13, wherein the Cartesian polarizing beamsplitter is disposed so that illumination light reaching the color separation prism assembly via the Cartesian polarizing beamsplitter is in substantially the same polarization state across all color bands.

Appendix B
Marked Up Version of Amendments to Specification

Kindly change the first paragraph, page 2 to read as follows:

The present application is a continuation-in-part of commonly-assigned U. S. Patent Application Serial No. 09/312,917, "Reflective LCD Projection System Using Wide-Angle Cartesian Polarizing Beam Splitter", filed on May 17 [5], 1999, which is hereby incorporated by reference. The present application also claims priority from commonly assigned U.S. Provisional Application No. 60/178,973 entitled "Reflective LCD Projection System Using Wide-Angle Cartesian Polarizing Beam Splitter and Color Separation and Recombination Prisms", filed January 25 [6], 2000, which is hereby incorporated by reference.